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From the Editor

The Active Galaxies Newsletter is produced monthly. The deadline for contributions is the last friday of the month. The Latex macros for submitting abstracts and dissertation abstracts are appended to each issue of the newsletter and are also available on the web page.

As always as editor of the newsletter I am very interested to hear any suggestions or feedback regarding the newsletter. So do not hesitate in emailing me your suggestions.

Many thanks for your continued subscription.

Melanie Gendre

Abstracts of recently accepted papers

The non-causal origin of the black hole–galaxy scaling relations

Knud Jahnke[1] and Andrea Macciò[1]

[1] Max Planck Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany

We show that the $M_{\rm BH}$–$M_{\rm bulge}$ scaling relations observed from the local to the high-z Universe can be largely or even *entirely* explained by a non-causal origin, i.e. they do not imply the need for any physically coupled growth of black hole and bulge mass, for example through feedback by active galactic nuclei (AGN). Provided some physics for the absolute normalisation, the creation of the scaling relations can be fully explained by the hierarchical assembly of black hole and stellar mass through galaxy merging, from an initially uncorrelated distribution of BH and stellar masses in the early Universe. We show this with a suite of dark matter halo merger trees for which we make assumptions about (uncorrelated) black hole and stellar mass values at early cosmic times. We then follow the halos in the presence of global star formation and black hole accretion recipes that (i) work without any coupling of the two properties per individual galaxy and (ii) correctly reproduce the observed star formation and black hole accretion rate density in the Universe. With disk-to-bulge conversion in mergers included, our simulations even create the observed slope of $\sim$1.1 for the $M_{\rm BH}$–$M_{\rm bulge}$-relation at $z = 0$. This also implies that AGN feedback is not a required (though still a possible) ingredient in galaxy evolution. In light of this, other mechanisms that can be invoked to truncate star formation in massive galaxies are equally justified.

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E-mail contact: jahnke@mpia.de,
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More evidence for extinction of activity in galaxies

A. Marecki[1] **and B. Swoboda**[1]

[1] Toruń Centre for Astronomy, N. Copernicus University, Poland

This Research Note amends an article in which we showed that radio-loud quasars can become radio-quiet. Exploring the analogy between galactic nuclei and X-ray binaries (XRB), we pointed out there that this transition in quasars could be identified with a switch from low/hard to high/soft state in microquasars. Here, we present the evidence that traces of past occurrences of this kind of phenomena can be found in normal but once active galaxies. Based on the properties of a few such "post-active" galaxies that are representative for a much wider group, it has been argued that they have reached the evolutionary stages when their nuclei, which were radio-loud in the past, now, mimicking the behaviour of XRBs, remain in the intermediate state on their way towards quiescence or even have already entered the quiescent state. It follows that the full evolutionary track of XRBs can be mapped onto the evolution of galaxies. The above findings are in line with those reported recently for IC 2497, a galaxy that 70,000 years ago or less hosted a quasar but now appears as a normal one. This scenario stems from the presence of Hanny's Voorwerp, a nebulous object in its vicinity excited by that QSO in the epoch when IC 2497 was active. The post-active galaxies we deal with here are accompanied by extremely weak and diffuse relic radio lobes that were inflated during their former active period. These relics can be regarded as radio analogues of Hanny's Voorwerp.

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E-mail contact: amr@astro.uni.torun.pl,
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Zooming into the broad line region of the gravitationally lensed quasar QSO 2237+0305 ≡ the Einstein Cross

D. Sluse[1], **R. Schmidt**[1], **F. Courbin**[2], **D. Hutsemékers**[3], **G. Meylan**[2], **A. Eigenbrod**[2], **T. Anguita**[4,5], **E. Agol**[6], **J. Wambsganss**[1]

[1] Astronomisches Rechen-Institut am Zentrum für Astronomie der Universität Heidelberg Mönchhofstrasse 12-14, 69120 Heidelberg, Germany
[2] Laboratoire d'Astrophysique, Ecole Polytechnique Fédérale de Lausanne (EPFL), Observatoire de Sauverny, 1290 Versoix, Switzerland
[3] Institut d'Astrophysique et de Géophysique, Université de Liège, Allée du 6 Août 17, B5c, 4000 Liège, Belgium
[4] Centro de Astro-Ingeniería, Departamento de Astronomía y Astrofísica, P. Universidad Católica de Chile, Casilla 306, Santiago, Chile
[5] Max-Planck-Institut für Astronomie, Königstuhl 17, 69117 Heidelberg, Germany
[6] Astronomy Department, University of Washington, Box 351580, Seattle, WA 98195, USA

Aims: We aim to use microlensing taking place in the lensed quasar QSO 2237+0305 to study the structure of the broad line region and measure the size of the region emitting the C IV and C III lines.
Methods: Based on 39 spectrophotometric monitoring data points obtained between Oct. 2004 and Dec. 2007, we derived lightcurves for the C IV and C III emission lines. We used three different techniques to analyse the microlensing signal. Different components of the lines (narrow, broad, and very broad) were identified and studied. We built a library of the simulated microlensing lightcurves that reproduce the signal observed in the continuum and in the lines provided only the source size is changed. A Bayesian analysis scheme is then developed to derive the size of the various components of the BLR.
Results: 1. The half-light radius of the region emitting the C IV line is found to be $R_{CIV} \sim 66^{+110}_{-46}$ light-days $= 0.06^{+0.09}_{-0.04}$ pc $= 1.7^{+2.8}_{-1.1}\,10^{17}$ cm (at 68.3% CI). Similar values are obtained for C III. Relative sizes of the carbon-line and V-band continuum emitting-regions are also derived with median values of $R^{\rm line}/R^{\rm cont}$ in the range 4 to 29, depending on the FWHM of the line component.
2. The size of the C IV emitting region agrees with the radius-luminosity relationship derived from reverberation mapping. Using the virial theorem, we derive the mass of the black hole in QSO 2237+0305 to be $M_{BH} \sim 10^{8.3\pm0.3} M_{\odot}$.
3. We find that the C IV and C III lines are produced in at least 2 spatially distinct regions, the most compact one giving rise to the broadest component of the line. The broad and narrow line profiles are slightly different for C IV and C III.
4. Our analysis suggests a different structure for the C IV and Fe $II + III$ emitting regions, with the latter produced in the inner part of the BLR or in a less extended emitting region than C IV.

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Star Formation Efficiency in the Cool Cores of Galaxy Clusters

Michael McDonald[1], Sylvain Veilleux[1], David S. N. Rupke[2], Richard Mushotzky[1], and Christopher Reynolds[1]

[1] Department of Astronomy, University of Maryland, College Park, MD 20742
[2] Department of Physics, Rhodes College, Memphis, TN 38112

We have assembled a sample of high spatial resolution far-UV (Hubble Space Telescope Advanced Camera for Surveys Solar Blind Channel) and Hα (Maryland-Magellan Tunable Filter) imaging for 15 cool core galaxy clusters. These data provide a detailed view of the thin, extended filaments in the cores of these clusters. Based on the ratio of the far-UV to Hα luminosity, the UV spectral energy distribution, and the far-UV and Hα morphology, we conclude that the warm, ionized gas in the cluster cores is photoionized by massive, young stars in all but a few (Abell 1991, Abell 2052, Abell 2580) systems. We show that the extended filaments, when considered separately, appear to be star-forming in the majority of cases, while the nuclei tend to have slightly lower far-UV luminosity for a given Hα luminosity, suggesting a harder ionization source or higher extinction. We observe a slight offset in the UV/Hα ratio from the expected value for continuous star formation which can be modeled by assuming intrinsic extinction by modest amounts of dust (E(B-V) $\sim$ 0.2), or a top-heavy IMF in the extended filaments. The measured star formation rates vary from ~ 0.05 M$_\odot$ yr^{-1} in the nuclei of non-cooling systems, consistent with passive, red ellipticals, to ~ 5 M$_\odot$ yr^{-1} in systems with complex, extended, optical filaments. Comparing the estimates of the star formation rate based on UV, Hα and infrared luminosities to the spectroscopically-determined X-ray cooling rate suggests a star formation efficiency of 14^{+18}_{-8}%. This value represents the time-averaged fraction, by mass, of gas cooling out of the intracluster medium which turns into stars, and agrees well with the global fraction of baryons in stars required by simulations to reproduce the stellar mass function for galaxies. This result provides a new constraint on the efficiency of star formation in accreting systems.

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E-mail contact: mcdonald@astro.umd.edu,
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Polarimetry of optically selected BL Lac candidates from the SDSS

J. Heidt[1], and K. Nilsson[2]

[1] ZAH, Landessternwarte Heidelberg, Königstuhl, D-69117 Heidelberg, Germany
[2] Finnish Centre for Astronomy with ESO (FINCA), University of Turku, Väisäläntie 20, FI-21500 Piikkiö, Finland

We present and discuss polarimetric observations of 182 targets drawn from an optically selected sample of 240 probable BL Lac candidates out of the SDSS compiled by Collinge et al. (2005). In contrast to most other BL Lac candidate samples extracted from the SDSS, its radio- and/or X-ray properties have not been taken into account for its derivation. Thus, because its selection is based on optical properties alone, it may be less prone to selection effects inherent in other samples derived at different frequencies, so it offers a unique opportunity to extract the first unbiased BL Lac luminosity function that is suitably large in size. We found 124 out of 182 targets (68%) to be polarized, 95 of the polarized targets (77%) to be highly polarized (> 4%). The low-frequency peaked BL Lac candidates in the sample are on average only slightly more polarized than the high-frequency peaked ones. Compared to earlier studies, we found a high duty cycle in high polarization ($\sim 66^{+2}_{-14}$% to be > 4% polarized) in high-frequency peaked BL Lac candidates. This may come from our polarization analysis, which minimizes the contamination by host galaxy light. No evidence of radio-quiet BL Lac objects in the sample was found. Our observations show that the probable sample of BL Lac candidates of Collinge et al. (2005) indeed contains a large number of bona fide BL Lac objects. High S/N spectroscopy and deep X-ray observations are required to construct the first luminosity function of optically selected BL Lac objects and to test more stringently for any radio-quiet BL Lac objects in the sample.

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E-mail contact: jheidt@lsw.uni-heidelberg.de,
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Spotting the misaligned outflows in NGC 1068 using X-ray polarimetry

René W. Goosmann[1] **and Giorgio Matt**[2]

[1] Observatoire astronomique de Strasbourg, Equipe Hautes Energies, 11 rue de l'Université, F-67000 Strasbourg, France
[2] Dipartimento di Fisica, Università degli Studi Roma Tre, Via della Vasca Navale 84, I-00146 Roma, Italy

We model the expected X-ray polarisation induced by complex reprocessing in the active nucleus of the Seyfert-2 galaxy NGC 1068. Recent analysis of infrared interferometry observations suggests that the ionised outflows ejected by the central engine are not aligned with the symmetry axis of the obscuring torus. This conclusion was obtained by extrapolating the apparent orientation of the narrow line region to the inner parts of the ionisation cones. We show that future measurements of the soft X-ray polarisation vector unambiguously determine the orientation of the ionisation cones. Furthermore, X-ray polarimetry across a broad photon energy range may independently verify the misalignment between the ionisation cones and the axis of the torus. To model the expected polarisation percentage and position angle, we apply the radiative transfer code STOKES. Reprocessing of the primary X-ray radiation takes place in the accretion disc, the surrounding equatorial torus and the inclined, ionised outflows. We also examine additional equatorial scattering occurring in between the accretion disc and the inner surfaces of the torus. Radiative coupling between the different reprocessing components is computed coherently. The resulting polarisation properties depend on the optical depth of the reprocessing regions and on the viewing angle of the observer. We show that even under unfavourable conditions the misalignment of the outflows with respect to the torus axis can be determined from a rotation of the polarisation position angle between softer and harder X-rays. We argue that the misalignment of the outflows with respect to the torus axis in NGC 1068 may be constrained by a future X-ray mission if equipped with a broad band polarimeter.

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E-mail contact: rene.goosmann@astro.unistra.fr,
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A Population of X-ray Weak Quasars: PHL 1811 Analogs at High Redshift

Jianfeng Wu[1,2]**, W. N. Brandt**[1,2]**, Patrick B. Hall**[3]**, Robert R. Gibson**[4]**, Gordon T. Richards**[5]**, Donald P. Schneider**[1]**, Ohad Shemmer**[6]**, Dennis W. Just**[7]**, Sarah J. Schmidt**[4]

[1] Department of Astronomy & Astrophysics, The Pennsylvania State University, 525 Davey Lab, University Park, PA 16802, USA
[2] Institute for Gravitation and the Cosmos, The Pennsylvania State University, University Park, PA 16802, USA
[3] Department of Physics & Astronomy, York University, 4700 Keele Street, Toronto, ON M3J 1P3, Canada
[4] Department of Astronomy, University of Washington, Box 351580, Seattle, WA 98195, USA
[5] Department of Physics, Drexel University, 3141 Chestnut Street, Philadelphia, PA 19104, USA
[6] Department of Physics, University of North Texas, Denton, TX 76203, USA
[7] Steward Observatory, University of Arizona, 933 North Cherry Avenue, Tucson, AZ 85721, USA

We report the results from *Chandra* and *XMM-Newton* observations of a sample of 10 type 1 quasars selected to have unusual UV emission-line properties (weak and blueshifted high-ionization lines; strong UV Fe emission) similar to those of PHL 1811, a confirmed intrinsically X-ray weak quasar. These quasars were identified by the Sloan Digital Sky Survey at high redshift ($z \approx 2.2$); eight are radio quiet while two are radio intermediate. All of the radio-quiet PHL 1811 analogs, without exception, are notably X-ray weak by a mean factor of ≈ 13. These sources lack broad absorption lines and have blue UV/optical continua, supporting the hypothesis that they are intrinsically X-ray weak like PHL 1811 itself. However, their average X-ray spectrum appears to be harder than those of typical quasars, which may indicate the presence of heavy intrinsic X-ray absorption. Our sample of radio-quiet PHL 1811 analogs supports a connection between an X-ray weak spectral energy distribution (SED) and PHL 1811-like UV emission lines; this connection provides an economical way to identify X-ray weak type 1 quasars. The fraction of radio-quiet PHL 1811 analogs in the radio-quiet quasar population is estimated to be $\leq 1.2\%$. We have investigated correlations between relative X-ray brightness and UV emission-line properties (e.g., C IV equivalent width and blueshift) for a sample combining our radio-quiet PHL 1811 analogs, PHL 1811 itself, and typical type 1 quasars. These correlation analyses suggest that PHL 1811 analogs may have extreme wind-dominated broad emission-line regions. Observationally, the radio-quiet PHL 1811 analogs appear to be a subset ($\approx 30\%$) of radio-quiet weak-line quasars. The existence of a subset of quasars in which high-ionization "shielding gas" covers most of the BELR, but little more than the BELR, could potentially unify the PHL 1811 analogs and WLQs. The two radio-intermediate PHL 1811 analogs are X-ray bright. X-ray spectral analyses and consideration of their multiwavelength properties suggest that one of them has jet-dominated X-ray emission, while the nature of the other

remains unclear.

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Investigating the nuclear activity of barred spiral galaxies: the case of NGC 1672

L. P. Jenkins[1,2], W. N. Brandt[3,4], E. J. M. Colbert[2], B. Koribalski[5], K. D. Kuntz[2], A. J. Levan[6], R. Ojha[7], T. P. Roberts[8], M. J. Ward[8], A. Zezas[9]

[1]Laboratory for X-ray Astrophysics, NASA Goddard Space Flight Center, Code 662, Greenbelt, MD 20771, USA
[2]Johns Hopkins University, 3400 N. Charles St, Baltimore, MD 21218, USA
[3]Department of Astronomy & Astrophysics, The Pennsylvania State University, 525 Davey Lab, University Park, PA 16802, USA
[4]Institute for Gravitation and the Cosmos, The Pennsylvania State University, University Park, PA 16802, USA
[5]CSIRO, Australia Telescope National Facility (ATNF), PO Box 76, Epping NSW 1710, AUSTRALIA
[6]Department of Physics, University of Warwick, Coventry, CV4 7AL, UK
[7]NVI/United States Naval Observatory, 3450 Massachusetts Ave NW, Washington DC 20392, USA
[8]Department of Physics, Durham University, South Road, Durham, DH1 3LE, UK
[9]Department of Physics, University of Crete, PO Box 2208, GR-71003 Heraklion, Greece

We have performed an X-ray study of the nearby barred spiral galaxy NGC 1672, primarily to ascertain the effect of the bar on its nuclear activity. We use both *Chandra* and *XMM-Newton* observations to investigate its X-ray properties, together with supporting high-resolution optical imaging data from the *Hubble Space Telescope* (*HST*), infrared imaging from the *Spitzer Space Telescope*, and ATCA ground-based radio data. We detect 28 X-ray sources within the D_{25} area of the galaxy, many of which correlate spatially with star-formation in the bar and spiral arms, while two are identified as background galaxies in the *HST* images. Nine of the X-ray sources are ULXs, with the three brightest ($L_X > 5 \times 10^{39}$ erg s^{-1}) located at the ends of the bar. With the spatial resolution of *Chandra*, we are able to show for the first time that NGC 1672 possesses a hard ($\Gamma \sim 1.5$) nuclear X-ray source with a 2–10 keV luminosity of 4×10^{38} erg s^{-1}. This is surrounded by an X-ray bright circumnuclear star-forming ring, comprised of point sources and hot gas, which dominates the 2–10 keV emission in the central region of the galaxy. The spatially resolved multiwavelength photometry indicates that the nuclear source is a low-luminosity AGN (LLAGN), but with star formation activity close to the central black hole. A high-resolution multiwavelength survey is required to fully assess the impact of both large-scale bars and smaller-scale phenomena such as nuclear bars, rings and nuclear spirals on the fueling of LLAGN.

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E-mail contact: Leigh.Jenkins@nasa.gov,
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Study of LINER sources with broad Hα emission. X-ray properties and comparision to luminous AGN and X-ray binaries

G. Younes[1], D. Porquet[2], B. Sabra, and J.N. Reeves[3]

[1] Observatoire Astronomique de Strasbourg, Université de Strasbourg, CNRS, UMR7550, 11 rue de l'Université, F-67000 Strasbourg, France
[2] Department of Physics & Astronomy, Notre Dame University-Louaize, P.O.Box 72, Zouk Mikael, Lebanon
[3] Astrophysics Group, School of Physical & Geographical Sciences, Keele University, Keele, Staffordshire ST5 5BG, U.K.

An important number of multiwavelength studies of low ionization nuclear emission-line regions (LINERs) were dedicated to investigate the excitation mechanism responsible for the detected emission lines. Radiative emission from accretion into a super massive black hole (SMBH) is now believed to be, in an increasing number of LINERs, the source of excitation. However, the accretion mode is not yet firmly understood, and could be explained in either a thin accretion disk or a radiatively inefficient accretion flow (RIAF). Our purpose is to study the X-ray properties of LINER sources with definite detection of a broad Hα emission line in their optical spectra, LINER 1s from Ho et al. sample. These objects preferentially harbor a low luminosity active nucleus at the center and show small or no intrinsic absorption ($\leq 10^{22}$cm^{-1}). We compare their X-ray properties to both X-ray binaries and luminous AGN. We analyzed all available X-ray archived *XMM-Newton* and *Chandra* observations of 13 LINER 1s satisfying the above criterion in a systematic homogeneous way. We looked for any correlations between the X-ray properties and the intrinsic parameters of our sample of LINER 1s. An absorbed power-law gave a good fit to the spectra of 9 out of the 13 sources in our sample. A combination of a thermal component and an absorbed power-law were required in the remaining 4 sources. We found a photon index for our sample between 1.3 ± 0.2 for the hardest source and $2.4^{+0.2}_{-0.3}$ for the softest one with a mean value of 1.9 ± 0.2 and a dispersion $\sigma = 0.3$. The thermal component had a mean temperature kT≈ 0.6 keV. Significant short (hours to days) time-scale variability is not common in the present sample and was observed in only 2 sources (NGC 3226 and NGC 4278). Three other sources indicate a possible variability with a low K-S test probability (2%–4%) that the nuclear emission originates from a constant source. On the other hand, significant variability on a longer time-scale (months to years) is detected in 7 out of the 9 sources observed more than once. No significant Fe Kα emission line at 6.4 keV was detected and upper limits were derived for the 4 sources with a high enough signal to noise ratio around 6 keV. Finally, we established, for the first time for a sample of LINER 1s, that the photon index Γ is significantly anticorrelated to $L_{2-10\ keV}/L_{Edd}$. Whereas this anticorrelation is in contrast to the positive correlation found for type 1 AGN, it is similar to the one seen in XRBs in their low/hard state where a radiatively inefficient accretion flow is thought to be responsible for the X-ray emitted energy.

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E-mail contact: georges.younes@astro.unistra.fr,
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